Lyme Disease and Mediterranean Diet
A Review of Literature

Thomas, Matthew
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Lyme disease is currently the number one vector-borne disease in the United States. The first incidence of Lyme disease occurred in the town of Lyme, Connecticut in 1975 [1]. Since then, it has been identified in all 50 states over the past 10 years [2] with over 27,000 new cases reported annually [3]. Additional studies show that the actual cases of Lyme disease may exceed the reported cases by a factor of six to twelve in prevalent areas due to its high rate of misdiagnosis and its widespread symptoms [4]. Lyme disease is a pathogenic bacterial infection that is transmitted to humans from a black legged deer tick named *Ixodes scapularis* [1]. The bacterium transmitted is *Borellia burgdorferi* which travels throughout the human body leading to many symptoms. There are three distinct stages of Lyme disease each having its own treatment regimen [3]. Even though this bacterial infection cannot be prevented through diet, studies show that the practice of the Mediterranean diet helps reduce inflammation, oxidative stress [8], and possibly chronic pain from arthritis [9], and fatigue [10].

The *Ixodes scapularis* is commonly named deer tick due to its common location on or around deer. The *Ixodes scapularis* can also found on mice or on the grounds of wooded areas [1]. The size of a mature *Ixodes scapularis* is about the size of a poppy seed. The small size of this tick is what makes it challenging to detect at first. *Ixodes scapularis* harbors the bacterium *B. burgdorferi* in its body. This bacterium is a spirochete bacterium meaning its shape is spiral which allows the bacteria to travel throughout the blood stream and/or lymphatic system at a rapid pace and to travel deep into human tissues. This anatomy of *B. burgdorferi* is one of the contributing factors why there is a long list of symptoms. The transmission of Lyme disease begins with the *Ixodes scapularis*. The tick attaches to its host and latches onto the host’s skin. During this time of attachment, the tick extracts the host’s blood while transmitting *B. burgdorferi* into the hosts’ bloodstream and/or lymphatic system. The tick must remain attached to the host for 24-36 hours in order to successfully transmit *B. burgdorferi* into the host [3].
Lyme disease is classified into three stages each having its own set of symptoms. These three stages include Stage One- early localized infection, Stage Two- disseminated infection, and Stage Three-late disseminated infection. The first stage early localized infection is the most common stage of Lyme disease. It begins anywhere from three to thirty days after the initial point of infection. The common symptoms experienced in this stage include the presence of an erythema migrans rash (EM rash), and other flu-like symptoms such as: fever, chills, joint pain, headache, and fatigue. Arthritis has also been reported with swelling, stiffness, and pain. The EM rash is oftentimes coined as the “hallmark” of this disease due to its uniqueness among other common rashes and symptoms. The EM rash is located at the point of attachment from the infected *Ixodes Scapularis*. This rash varies in size and often times contain a “bulls-eye” shape within the rash which is representative of the EM rash. It is important to mention that 10% of patients in this stage do not exhibit the EM rash which can lead to misdiagnosis or no diagnosis until the later stages of Lyme disease.

The second stage, early disseminated infection, occurs in Lyme patients whom have not yet been properly diagnosed and therefore not properly treated. This stage occurs within a few days to ten months after the initial point of infection. During this stage, the symptoms of Lyme disease become more neurological and severe and include memory loss, light-headiness, joint pain (especially in knees), nausea, Bell’s palsy and sensory loss. At this point, if the patient is still misdiagnosed, *B. burdoferi* is still traveling and replicating inside the patient’s body which leads to further enhanced symptoms. The final stage of Lyme disease is the late disseminated infection stage which occurs weeks to years after the initial point of infection. In this stage, the patients have not yet been properly diagnosed and therefore have not yet to receive proper antibiotic treatment for early Lyme disease. Of the patients in the late disseminated stage, approximately 60% will begin to have intermittent arthritis with severe joint pain and swelling. Chronic arthritis develops in 10-20% of patients, and the remaining 5% of untreated patients may develop chronic neurological complications such as motor and sensory nerve damage as
well as brain inflammation. The exact cause of these chronic symptoms is not yet known \cite{3}. Just as there are three distinct infected stages of Lyme disease, there are three treatment regimens catered for each stage of this disease.

The treatment of Lyme disease is categorized into two options: Conventional treatment and Natural-Complementary treatment. Conventional treatment is the treatment of choice for the vast majority of Lyme disease patients. This treatment includes the use of antibiotics particularly doxycycline or more preferably, amoxicillin. The dosage and application method of amoxicillin is determined based on the specific infection stage of Lyme disease the patient is experiencing. In the early localized infection stage, amoxicillin is taken orally for four to eight weeks in order to successfully terminate all \textit{B.burgdoferi} in the body. In the next stage, amoxicillin may be taken orally or intravenous for four to six months depending on the presence of neurological symptoms \cite{2}. The treatment regimen for the late disseminated infection stage involves the use of non-steroidal anti-inflammatory drugs (NSAIDS) or corticosteroid due to the unresponsiveness of antibiotics, and to reduce the chronic arthritis symptoms.

Another method of treatment of Lyme disease other than the use of antibiotics is the use of natural therapies. The existence of evidence-based research in regards to natural treatment as an alternative to antibiotic use for Lyme disease is incredibly scarce; however, natural therapies may be used to compliment antibiotic therapy. The natural-complementary therapies associated with Lyme disease treatment include cat’s claw, ginger root, stinging nettles, licorice and Echinacea probiotics. Cat’s claw is a manufactured natural supplement containing pentacyclic osindole alkaloids (POAs), tetracyclic osindole alakoids (TOAs), antibacterial and anti-inflammatory constituents. Ginger root, stinging nettles, and licorice are other natural supplements with antibacterial and anti-inflammatory properties \cite{3}. As noted, Lyme disease is a complex disease because of recent origins and its variety of symptoms which lead to many complications encountered by both the patient and the physician.
The complexity of Lyme disease has raised many barriers in creating the standardization of guidelines for Lyme disease. A major complication of this disease is its clinical definition. In 2006, the Infectious Disease Society of America (IDSA) published its clinical guidelines regarding the diagnosis and testing of Lyme disease that contradicted those of the following organization: The International Lyme and Associated Disease Society (ILADS). The ISDA claims that the incidence of Lyme disease depends on the presence of the EM rash versus the ILADS which states that the incidence of Lyme disease does not require the presence of the EM rash. In regards to laboratory testing for the presence of *B. burgdorferi* in patients’ blood serum, the ISDA requires evidence of immunoglobulin IgG antibodies present in the patient serum detected by a Western blot assay. On the contrary, the ILADS argues that more accurate laboratory tests for Lyme disease are available to provide a broader coverage and include more accurate testing reagents. The viewpoints of the treatment of Lyme disease in the late disseminated infection stage vary between these two organizations as well. The ISDA opposes the use of long-term intravenous antibiotic treatment in patients with re-emerging (chronic) Lyme disease patient claiming that the consequences of this application are too risky. The ILADS supports the use of long-term intravenous antibiotic therapy in chronic Lyme disease patients. The polarity of viewpoints between the IDSA and the ILADS about the guidelines for Lyme disease is creating enormous friction between the physician, and the insurance companies all of which directly affects the diagnosis and laboratory testing, and the treatment of Lyme disease patient [5].

Another barrier of Lyme disease is its wide range of symptoms. In the first stage of Lyme, there is a long list of symptoms which a Lyme patient may exhibit. A primary example is the presence of the EM rash in the early localized infection stage. A retrospective review was performed by Aucott et al. in 2009 revealing the results of Lyme disease patients that do not portray the EM rash. In short, this retrospective review explains that the dependence of the bull’s eye EM rash as being the only diagnostic symptom of Lyme disease will continue to contribute to the high rate of misdiagnoses and non-
diagnoses of Lyme disease \(^4\). With the incidence, diagnosis, treatment, and complications of Lyme disease explained, can diet help reduce the symptoms or the overall health of the patient before, during, and after their battle with Lyme disease?

Over the past few decades the scope nutrition has greatly widened due to new evidence-based research discoveries regarding how diet and nutrition play an active role in the prevention of many known chronic diseases in the United States. These chronic diseases include hypertension, diabetes, heart disease, and arthritis. According to the CDC, these diet-related chronic diseases are the leading cause of death and the most costly diseases in the United States. Yet, they are the most preventable of all health problems in the United States \(^6\). This is clear evidence that diet has a direct impact on our overall health as well as on many diseases. Given the characteristics of Lyme disease, diet alone cannot cure the bacterial-related disease. However, it is evident that proper diet and nutrition can create a solid foundation for the overall health of all people. Thus diet can also play a role in the overall health of a Lyme disease patient throughout the prognosis of this disease. Some properties of nutrition that play a positive role during the treatment of Lyme disease include probiotics, vitamins, minerals, and essential fatty acids (EFAs).

Doctor James Burrascano, a well renowned physician in the diagnosis and treatment of chronic-tick borne diseases (especially Lyme disease), has published a set of guidelines about the diagnosis and treatment guidelines for Lyme and other tick-borne diseases. In one of the sections of this publication, Dr. Burrascano lists the basic nutritional regimens required along with the antibiotic therapy. The first regimen listed is probiotics specifically kefir and acidophilus. Kefir is a probiotic whose function is to replenish healthy bacterial flora that is continuously being lost due to antibiotic therapy. Kefir comes in a yogurt-like drink and is recommended to consume 2-4 ounces daily. Another probiotic is acidophilus which is also used to replenish beneficial bacteria being flushed away due to high levels of antibiotics.
Acidophilus is found in a tablet form available at many supermarkets and vitamin retail stores. Vitamin B has been shown in clinical studies to help clear neurological symptoms in Lyme patients. Burrascano recommends a daily capsule of 50 mg of B-complex. If severe neurological symptoms are present, an additional 50 mg of vitamin B-6 is also recommended. Magnesium supplementation has been shown to help with tremors, twitches, cramps, muscle soreness, and weakness all of which are commonly experienced in one or many stages of Lyme disease. Higher doses increase its effectiveness but may lead to side effects so foods high in magnesium may be an excellent substitute. Studies show that Omega 3 EFA are beneficial in the reduction of fatigue, aches, weakness, dizziness, memory, concentration, and depression. As previously mentioned, diet is a major contributor to the prevention of many diet related diseases in America. Although Lyme disease is not a diet-related disease, proper nutrition may complement the antibiotic therapy a Lyme patient endures. A good nutritional principle Lyme disease patients can follow is the Mediterranean Diet which is a healthy diet consisting of foods high in unsaturated fat, Omega-3 EFAs, and antioxidants that is believed to alleviate some symptoms of the disease as well complementing the antibiotic therapy.

The Mediterranean diet is not only a diet with an emphasis on the consumption of whole grains, fruits, and vegetables but also offers a healthy lifestyle. The Mediterranean diet derives from the culture in the countries bordering the Mediterranean Sea. Throughout history, countries in this region shaped their culture around their local foods sources. Due to their location, there was an abundance of fruits, vegetables, whole grains, legumes, olive oil, and their protein source mostly derived from fish. This diet plentiful in fruits and vegetables are low in fat, sodium and contain no cholesterol. Oftentimes many of these fruits and vegetables contain antioxidants which can prevent oxidative stress. The abundance in whole grains found in breads, pastas, and rice provide an excellent source of fiber and contain an array of vitamins and minerals. Olive oil is the primary source of fat used not only because of its great quantity but also due to its structure of monounsaturated fats which can aid in lowering LDL cholesterol and
improve overall heart health. One of the main protein sources are shellfish and finfish due to its location, low fat content and presence of omega-3 EFAs \(^8\). The components of the Mediterranean diet may not only be able to relieve some of the symptoms of Lyme disease but more importantly, improve the overall health of the patient before, during and after the diagnosis of Lyme disease.

Components of the Mediterranean diet are categorized in a tier-like fashion as shown in figure 2. As shown in this figure, the foods that are nutrient dense, low in saturated fat and sodium, plus have no cholesterol are at the base of the pyramid. Meats and sweets are at the top tier due to their high levels of saturated fat, and refined carbohydrates, are food groups that should be the least consumed. The Mediterranean diet is beneficial for Lyme disease patients by helping reduce inflammation, oxidation and offers a healthy lifestyle from everyone can benefit. A disadvantage of the Mediterranean diet for Lyme patients is that it is not scientifically proven to always alleviate symptoms \(^8\). If the attributes of the Mediterranean diet in lowering inflammation and oxidation stress is applicable, Lyme patients can also benefit from the positive influence experienced by patients with Rheumatoid Arthritis (RA).

In this systematic review, Smedslund et al. evaluate the effectiveness and safety of dietary interventions for RA. Eight randomized control trials (RCT) were included in this systematic review. Throughout history, patients have tried different diets to test its effectiveness in improving RA symptoms. These diets include the Vegan, Mediterranean, Elimination, and the Vegetarian diet. These diets were tested to determine if dietary interventions are capable of producing health benefits including the decrease of inflammation often affiliated with chronic pain prevalent in RA patients. These diets were compared and analyzed with RA patients on an ordinary diet. For the purpose of this paper, the diet of focus is the Mediterranean diet.
One of the eight RCTs within this systematic review was the dietary intervention of the Mediterranean diet. This RCT lead by Sköldstam and colleagues had a sample size of 56 patients. The mean age of the intervention group was 59 and the gender of the sample size comprised of 82% female. The intervention included a nine week Cretan Mediterranean eating plan followed by three weeks of outpatient-based rehabilitation program where the patients were served the eating plan provided by the hospital cafeteria. The control group was advised not to experiment with their diet during the nine weeks and the remaining three weeks were spent in an outpatient-based rehabilitation program where they were served ordinary hospital food. At the end of the 12 week intervention, the measurement of the patients, pain, physical function, and morning stiffness of the intervention group was calculated and compared with the control group measurements. Sköldstam and colleagues reported a significant difference in pain (P=0.004) VAS (0 to 100mm) with the intervention group with a mean difference -14.00 (95% CI -23.63 to -4.37). After the 12 week study, Sköldstam and colleagues reported “non-significant differences” in physical function. However, there was a significant difference (P=0.012) reported change from the beginning to the end of the study measurements favoring the intervention group was reported. Mourning stiffness was the final measurement taken after the 12 week study. Sköldstam and colleagues reported a “non-significant difference” (P=0.11) in morning stiffness favoring the intervention group, with a mean difference of -26 minutes (95% CI -58.08 to 6.08). Although, there was a discrepancy between the two groups at the baseline measurement (the intervention group mean was 49 minutes versus the control group mean of 64 minutes).

This RCT affirmed a Cretan Mediterranean eating plan may reduce the pain of a patient with RA but shows no effect on physical function and morning stiffness. Some limitations mentioned in the systematic review include sample size of RCT and bias. The data collected from these eight RCTs are based on relatively small and mostly single RCT that were measured for moderate to high risk of bias [9]. This systematic review provides data supports that the Mediterranean diet is effective in the reduction
of pain for RA. Another study was conducted to test the effectiveness of the Mediterranean diet on mood and cognitive performance of healthy individuals.

McMillan et al. performed a single-blind parallel group trial testing the effectiveness of dietary interventions on mood and cognition of healthy individuals. Besides correlating a single nutrient with the cognition and mood changes, McMillan et al. wanted to measure the changes of cognition and mood based upon diet as a whole. The purpose of the single-blind parallel group trial was to evaluate if the Mediterranean diet improves mood and performance on cognitive task over a ten day period. The intervention group is noted as diet change (DC) and the control was noted as no diet change (NC). The sample size consisted of 25 females between the ages of 19-30. The DC group consisted of 12 females and the NC group included the remainder 13 females. Members in the DC group were provided with an at home eating plan outlining the foods that should be consumed. These foods follow the fundamental food groups of the Mediterranean diet. Red meats, refined sugar, flour, processed and pre-packaged foods, caffeinated products, soft drinks and condiments were all prohibited in the outlined eating plan. The caloric intake was not restricted. The NC group was instructed to continue their normal eating habits. Both groups were required to complete a daily food log throughout the trial. At the end of the 10-day trial, the food logs were forwarded and examined by an individual who was blind to the participants’ condition. If 80% of the data on the food log matched up with the initial guidelines, the participants were classified as successfully following the Mediterranean guidelines. The assessment of cognition was calculated by the Computerised Mental Performance Assessment which measured attention, working memory, long term memory and executive function.

The results of this trial were categorized into mood and cognition. Mood was then subcategorized into a variety of states, the focus in regards to Lyme disease was fatigue. Fatigue is commonly experienced throughout the disease as well as during antibiotic therapy. The DC group
reported a minor decrease in fatigue with a measurement of 16.17 pre-diet and 12.17 post-diet. The NC group had a very slight decrease in fatigue with a measurement of 14.18 pre diet and 14.08 post-diet.

The results of this trial show that there is a continued need for research and clinical trials. The measure of the effectiveness of the Mediterranean diet on mood and cognition is not yet clear. There are many limitations regarding this trial including the sample size and trial period. The sample size is very small having only 25 participants and all of them female. The trial period of 10 days is also too short to gather reliable data. The use of foods logs allows for a great margin of error which can be reflected in inaccurate data. Even though the participants did not know their eating plan was the Mediterranean diet, it is likely that the participants noticed the emphasis on healthy foods which may lead a psychological change in mood and cognition solely based on the knowledge of being on a healthy diet during the study\(^{[10]}\).

As nutrition professionals, we are able to exercise our knowledge of nutrition by providing good news to this growing public health concern. We can impact those with diagnosed or not-yet diagnosed Lyme disease patients by educating them on how nutrition may be able to alleviate some of the pain, inflammation, and fatigue often experienced. A good guideline for these patients to follow is the Mediterranean diet. This diet, high in unsaturated fats, vitamins, minerals, and antioxidants has the potential of benefiting Lyme patients either with the symptoms experienced, or to aid in the recovery. Although diet is not scientifically guaranteed to prevent or lessen Lyme disease symptoms, we are able to help expand the scope of nutrition and reveal the true power of a healthy diet and lifestyle.
Reference List


